# CHAPTER 8.0

# EVALUATON AND COMPARISON OF FLOOD CONTROL ALTERNATIVES

This chapter summarizes the environmental and economic aspects of the flood control alternatives, and identifies the Federally supportable storage plan and conveyance plan. Because implementing Alternatives 2, 3, 4, and 8 would reduce flood damages and help resolve Folsom Dam's current dam safety deficiency (see discussion in Chapter 2, 4, and 5), only a portion of the estimated cost of each of these alternatives has been allocated to flood control based on the separable cost/remaining benefits procedure described in Appendix B.

## 8.1 Alternative 2: 3.5-Foot Dam Raise/478-Foot Flood Pool Elevation

### 8.1.1 Environmental Effects and Mitigation

Construction-related activities associated with this alternative would have less-than-significant effects on land use and socioeconomics, recreation, water supply, hydropower, soils and geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle, traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, and public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Mitigation measures to reduce noise effects would include constructing a sound wall between the temporary construction bridge and a nearby apartment complex. However, this effect would remain significant. Potential effects on air quality would also remain significant depending on the availability of emission credits. Potential effects on recreation would be minimized by providing notification of trail closures and alternate routes, however, recreational effects from tail disruption from Beals Point to Beaks Bight would remain significant.

Effects on vegetation and wildlife from the temporary construction bridge would directly affect 4.6 acres of oak and pine-oak woodland and 1.3 acres of riparian woodland. To reduce these effects to a less-than-significant level, 12.72 acres of oak and pine-oak woodland and 1.3 acres of riparian woodland would be developed on project lands around Folsom Reservoir. Twenty-one elderberry shrubs would be removed under this alternative. Compensation for these shrubs would be included in the oak woodland plantings.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented. In addition, a flowage easement would be acquired over properties near Mooney Ridge that may be inundated during a large flood event.

As described in Section 7.8, operational effects on vegetation and wildlife are considered less than significant; therefore, no upfront mitigation is proposed. However, the local sponsor has agreed to develop an adaptive management plan that would be implemented in operation and maintenance of the project to ensure that there would be no unforeseen effects on vegetation and wildlife.

### 8.1.2 Plan Economics

The total first cost of Alternative 2, including environmental mitigation, is estimated at $176.1 million (Table 8-1). With an interest rate of 6.375 percent and a 50-year period of economic evaluation, the total annual cost of Alternative 2 is estimated at $12.7 million, including O&M costs of $0.4 million. Because this is a dual-purpose alternative that would reduce flood damages and address Folsom Dam's dam safety deficiency, the separable cost/remaining benefit procedure has been used to determine the portion of this cost that is allocable to flood control. The resulting allocation is $5.1 million (Table 8-2).

The annual benefits generated by this alternative include flood damage reduction, advance replacement of the Folsom Dam spillway bridge, and Folsom Modification Project cost savings. These benefits total $12.4 million without implementation of advance release and $12.2 million with implementation of moderate advance release (0-100,000-190,000 acre-feet) (Table 8-2). The net benefits are the total annual benefits minus the annual costs allocable to flood control. These net benefits are $7.3 million (no advance release) and $7.1 million (moderate advance release). Because the benefits exceed the costs, this alternative is considered to be economically feasible.

## 8.2 Alternative 3: Seven-Foot Dam Raise/482-Foot Flood Pool Elevation

### 8.2.1 Environmental Effects and Mitigation

Construction-related activities associated with this alternative would have less-than-significant effects on land use and socioeconomics, water supply, hydropower, soils and geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle, traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, and public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Mitigation measures to reduce noise effects would include constructing a sound wall between the temporary construction bridge and a nearby apartment complex; however, this effect would remain significant. Potential effects on air quality would also remain significant depending on the availability of emission credits. Potential effects on recreation would be minimized by providing notification of trail closures and alternate routes; however, recreational effects from trail disruption from Beals Point to Beaks Bight and the closure of Willow Creek recreational area would remain significant.

Effects on vegetation and wildlife from the temporary construction bridge and enlarging the embankment dam and dikes would result in the loss of 29.8 acres of oak and pine-oak woodland, 10.3 acres of riparian woodland, and 0.3 acre of seasonal wetland. Mitigation for this loss would consist of planting an additional 9 acres of riparian woodland and 0.3 acre of seasonal wetland at the Bureau's Mormon Island Wetland Preserve and planting 79 acres of oak and pine-oak woodland on project land around Folsom Reservoir. A total of 40 elderberry shrubs would be directly affected by construction. Compensation for these shrubs would be included in the oak woodland plantings around the reservoir.

**TABLE 8-1.** Estimated Costs of Alternative 2 (3.5-Foot Dam Raise/478-Foot Flood Pool Elevation) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost** [a] | |
| 01 | Lands and damages | 1.9 |
| 02 | Relocations | 0.0 |
| 04 | Construction | 121.9 |
| 18 | Cultural resources | 1.1 |
| 06 | Environmental mitigation | 6.4 |
| 30, 31 | Engineering, design, supervision, & administration | 28.3 |
| | Sunk PED costs | 16.5 |
| | **Total first cost** | **176.1** |

[a] Costs are October 2000 price level.

**TABLE 8-2.** Benefits and Costs of Alternative 2 (3.5-Foot Dam Raise/478-Foot Flood Pool Elevation) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 176.1 |
| Less cultural resources (data recovery) | (1.1) |
| Interest during construction | 25.7 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **184.2** |
| **Annual Cost** | |
| Interest & amortization [b] | 12.3 |
| Operation and maintenance cost | 0.4 |
| **Total annual cost** | **12.7** |
| **Annual Cost Allocable to Flood Control** | **5.1** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 9.1 |
| Folsom modification project surcharge cost savings [c] | 3.1 |
| Advance replacement of spillway bridge [d] | 0.2 |
| **Total benefits** | **12.4** |
| **Net annual benefits** [e] | **7.3** |
| **Benefit-to-cost ratio** [e] | **2.4** |
| ***Moderate Advance Release (0-100,000-190,000 Acre-Feet)*** | |
| Flood damage reduction | 8.9 |
| Folsom modification project surcharge cost savings | 3.1 |
| Advance replacement of spillway bridge | 0.2 |
| **Total benefits** | **12.2** |
| **Net annual benefits** | **7.1** |
| **Benefit-to-cost ratio** | **2.4** |

[a] Does not include PED sunk cost.

[b] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[c] The annual cost of the surcharge component of Folsom Modifications Project would no longer be necessary with this alternative.

[d] Spillway bridge would be built earlier than it would otherwise be under the No-Action Plan resulting in a cost savings.

[e] Net annual benefits and benefit –to-cost ratio use the annual cost allocable to flood control.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented. In addition, a flowage easement would be acquired over properties near Mooney Ridge that may be inundated during a large flood event.

As described in Section 7.8, operational effects on vegetation and wildlife are considered less than significant; therefore, no upfront mitigation is proposed. However, the local sponsor has agreed to develop an adaptive management plan that would be implemented in the operation and maintenance of the project to ensure that there would be no unforeseen effects on vegetation and wildlife.

### 8.2.2 Plan Economics

The total first cost of Alternative 3, including environmental mitigation, is estimated at $179.2 million (Table 8-3). With an interest rate of 6.375 percent and a 50-year period of economic evaluation, the total annual cost of Alternative 3 is estimated at $13.4 million, including O&M costs of $ 0.9 million. Because this is a dual-purpose alternative that would reduce flood damages and address Folsom Dam's dam safety deficiency, the separable cost/remaining benefit procedure has been used to determine the portion of this cost that is allocable to flood control. The resulting allocation is $6.6 million (Table 8-4).

The annual benefits generated by this alternative include flood damage reduction, advance replacement of the Folsom Dam spillway bridge, and Folsom Dam Modification Project cost savings. These benefits total $20.5 million without implementation of advance release and $18.9 million with implementation of moderate advance release (0-100,000-190,000 acre-feet) (Table 8-4). The net benefits are the total annual benefits minus the annual costs allocable to flood control. These net benefits are $13.9 million (no advance release) and $12.3 million (moderate advance release). Because the benefits exceed the costs, this alternative is considered to be economically feasible.

## 8.3 Alternative 4: Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation

### 8.3.1 Environmental Effects and Mitigation

Construction-related activities associated with this alternative would have less-than-significant effects on land use and socioeconomics, water supply, hydropower, soils and geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle, traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Mitigation measures to reduce noise effects would include constructing a sound wall between the temporary construction bridge and a nearby apartment complex; however, this effect would remain significant. Potential effects on air quality also would remain significant depending on the availability of emission credits. Potential effects on recreation would be minimized by providing notification of trail closures and alternate routes. However, recreational effects from trail disruption from Beals Point to Beaks Bight and the closure of Willow Creek recreational area would remain significant.

Effects on vegetation and wildlife from the temporary construction bridge and enlarging the embankment dam and dikes would result in the loss of 29.8 acres of oak and pine-oak woodland, 10.3 acres of riparian woodland, and 0.3 acre of seasonal wetland. Mitigation for this loss would consist of planting an additional 9 acres of riparian woodland and 0.3 acre of seasonal wetland at the Bureau's Mormon Island Wetland Preserve and planting 79 acres of oak and pine-oak woodland on project land around Folsom Reservoir. A total of 40 elderberry shrubs would be directly affected by construction. Compensation for these shrubs would be included in the oak woodland plantings around the reservoir.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented. In addition, a flowage easement would be acquired over properties near Mooney Ridge that may be inundated during a large flood event.

As described in Section 7.8, operational effects on vegetation and wildlife are considered less than significant; therefore, no upfront mitigation is proposed. However, the local sponsor has agreed to develop an adaptive management plan that would be implemented in operation and maintenance of the project to ensure that there would be no unforeseen effects on vegetation and wildlife.

### 8.3.2 Plan Economics

The total first cost of Alternative 4, including environmental mitigation, is estimated at $314.8 million (Table 8-5). With an interest rate of 6.375 percent and a 50-year period of economic evaluation, the total annual cost of Alternative 4 is estimated at $24.1 million, including O&M costs of $1.3 million. Because this is a dual-purpose alternative that would reduce flood damages and address Folsom Dam's dam safety deficiency, the separable cost/remaining benefit procedure has been used to determine the portion of this cost that is allocable to flood control. The resulting allocation is $16.2 million (Table 8-6).

The total annual benefits generated by this alternative include flood damage reduction, advance replacement of Folsom Dam's spillway bridge, and Folsom Dam Modification Project cost savings. These benefits total $27.5 million without implementation of advance release and $23.0 million with implementation of moderate advance release (0-100,000-190,000 acre-feet) (Table 8-6). The net benefits are the total annual benefits minus the annual costs allocable to flood control. These net benefits are $11.3 million (no advance release) and $6.8 million (moderate advance release). Because the benefits exceed the costs, this alternative is considered to be economically feasible.

## 8.4 Alternative 5: Stepped Release to 160,000 cfs

### 8.4.1 Environmental Effects and Mitigation

Construction-related activities associated with this alternative would have less-than-significant effects on land use and socioeconomics, recreation, water supply, hydropower, soils and geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle,

**TABLE 8-3.** Estimated Costs of Alternative 3 (Seven-Foot Dam Raise/482-Foot Flood Pool Elevation) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost** [a] | |
| 01 | Lands and damages | 3.5 |
| 02 | Relocations | 0.0 |
| 04 | Construction | 123.1 |
| 18 | Cultural resources | 1.2 |
| 06 | Environmental mitigation | 6.2 |
| 30, 31 | Engineering, design, supervision, & administration | 28.7 |
| | Sunk PED Costs | 16.5 |
| | **Total first cost** | **179.2** |

[a] Costs are October 2000 price level

**TABLE 8-4.** Benefits and Costs of Alternative 3 (Seven-Foot Dam Raise/482-Foot Flood Pool Elevation) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 179.2 |
| Less cultural resources (data recovery) | (1.2) |
| Interest during construction | 25.2 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **186.7** |
| **Annual Cost** | |
| Interest & amortization [b] | 12.5 |
| Operation and maintenance cost | 0.9 |
| **Total annual cost** | **13.4** |
| **Annual Cost Allocable to Flood Control** | **6.6** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 17.2 |
| Folsom modification project surcharge cost savings [c] | 3.1 |
| Advance replacement of spillway bridge [d] | 0.2 |
| **Total benefits** | **20.5** |
| **Net annual benefits** [e] | **13.9** |
| **Benefit-to-cost ratio** [e] | **3.1** |
| ***Moderate Advance Release (0-100,000-190,000 Acre-Feet)*** | |
| Flood damage reduction | 15.6 |
| Folsom modification project surcharge cost savings | 3.1 |
| Advance replacement of spillway bridge | 0.2 |
| **Total benefits** | **18.9** |
| **Net annual benefits** | **12.3** |
| **Benefit-to-cost ratio** | **2.9** |

[a] Does not include PED sunk cost.

[b] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[c] The annual cost of the surcharge component of Folsom Modifications Project would no longer be necessary with this alternative.

[d] Spillway bridge would be built earlier than it would otherwise be under the No-Action Plan resulting in a cost savings.

[e] Net annual benefits and benefit -to-cost ratio use the annual cost allocable to flood control.

**TABLE 8-5.** Estimated Costs of Alternative 4 (Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost** [a] | |
| 01 | Lands and damages | 7.0 |
| 02 | Relocations | 0.0 |
| 04 | Construction | 231.0 |
| 18 | Cultural resources | 2.1 |
| 06 | Environmental mitigation | 6.2 |
| 30, 31 | Engineering, design, supervision, & administration | 52.0 |
| | Sunk PED costs | 16.5 |
| | **Total first cost** | **314.8** |

[a] Costs are October 2000 price level.

**TABLE 8-6.** Benefits and Costs of Alternative 4 (Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 314.8 |
| Less cultural resources (data recovery) | (2.1) |
| Interest during construction | 45.1 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **341.3** |
| **Annual Cost** | |
| Interest & amortization [b] | 22.8 |
| Operation and maintenance cost | 1.3 |
| **Total annual cost** | **24.1** |
| **Annual Cost Allocable to Flood Control** | **16.2** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 24.2 |
| Folsom modification project surcharge cost savings [c] | 3.1 |
| Advance replacement of spillway bridge [d] | 0.2 |
| **Total benefits** | **27.5** |
| **Net annual benefits** [e] | **11.3** |
| **Benefit-to-cost ratio** [e] | **1.7** |
| ***Moderate Advance Release (0-100,000-190,000 Acre-Feet)*** | |
| Flood damage reduction | 19.7 |
| Folsom modification project surcharge cost savings | 3.1 |
| Advance replacement of spillway bridge | 0.2 |
| **Total benefits** | **23.0** |
| **Net annual benefits** | **6.8** |
| **Benefit-to-cost ratio** | **1.4** |

[a] Does not include PED sunk cost.

[b] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[c] The annual cost of the surcharge component of Folsom Modifications Project would no longer be necessary with this alternative.

[d] Spillway bridge would be built earlier than it would otherwise be under the No-Action Plan resulting in a cost savings.

[e] Net annual benefits and benefit -to-cost ratio use the annual cost allocable to flood control.

traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, and public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Best management practices to reduce noise effects on residences along the Lower American River would be implemented; however, this effect would remain significant. Potential effects on air quality also would remain significant depending on the availability of emission credits.

Project construction along the Lower American River would result in the loss of 6 acres of riparian habitat and 1.5 acres of oak woodland. Three elderberry shrubs also would be directly affected by project construction. These effects would be mitigated by developing 6 acres of riparian woodland at an appropriate site, such as Mississippi Bar, and 5.4 acres of oak woodland at Rossmoor Bar. Mitigation for the three elderberry shrubs would be included in the riparian and oak woodland plantings.

Construction of the hydraulic mitigation features would result in the loss of 16.6 acres of riparian woodland, 5.2 acres of oak woodland, 23.2 acres of freshwater marsh, 11.3 acres of open water, and 12.5 acres of rice fields. Construction of the hydraulic mitigation features could adversely affect the Federally listed giant garter snake, delta smelt, and Sacramento splittail as well as the State-listed Swainson's hawk. Mitigation would consist of creating 18 acres of riparian woodland, and 17.7 acres of oak woodland on Egbert Tract. To mitigate for adverse effects on Federally listed species, 141 acres of wetlands would be developed at Egbert Tract. Mitigation for the State-listed Swainson's hawk would consist of a buffer of up to 1/2 mile around any active nest site.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented.

### 8.4.2 Plan Economics

The total first cost of Alternative 5, including environmental mitigation, is estimated at $174.7 million (Table 8-7), and the total annual cost is estimated at $14.0 million, including interest and amortization and O&M costs (Table 8-8). The total annual benefits generated by this alternative are approximately $8.1 million without implementation of the advance release and $5.7 million with implementation of moderate advance release.

Because the benefits are less than the costs for the scenarios with and without moderate advance release, Alternative 5 is not considered to be economically feasible. Thus, there is no Federal interest in this alternative.

## 8.5 Alternative 6: Stepped Release to 160,000 cfs and New Outlet at Folsom Dam

### 8.5.1 Environmental Effects and Mitigation

Construction of the levee improvements and related infrastructure modifications along the Lower American River and the new outlet at Folsom Dam would have less-than-significant effects on land use and socioeconomics, recreation, water supply, hydropower, soils and

geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle, traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Best management practices to reduce noise effects on residences along the Lower American River would be implemented; however, this effect would remain significant. Potential effects on air quality also would remain significant depending on the availability of emission credits.

Project construction along the Lower American River would result in the loss of 6 acres of riparian habitat and 1.5 acres of oak woodland. Three elderberry shrubs also would be directly affected by project construction. These effects would be mitigated by developing 6 acres of riparian woodland at an appropriate site, such as Mississippi Bar, and 5.4 acres of oak woodland at Rossmoor Bar. Mitigation for the three elderberry shrubs would be included in the riparian and oak woodland plantings.

Construction of the hydraulic mitigation features would result in the loss of 16.6 acres of riparian woodland, 5.2 acres of oak woodland, 23.2 acres of freshwater marsh, 11.3 acres of open water, and 12.5 acres of rice fields. Construction of the hydraulic mitigation features could adversely affect the Federally listed giant garter snake, delta smelt, and Sacramento splittail as well as the State-listed Swainson's hawk. Mitigation would consist of creating 18 acres of riparian woodland, and 17.7 acres of oak woodland on Egbert Tract. To mitigate for adverse effects on Federally listed species, 141 acres of wetlands would be developed at Egbert Tract. Mitigation for the State-listed Swainson's hawk would consist of a buffer of up to 1/2 mile around any active nest site.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented.

### 8.5.2 Plan Economics

The total first cost of Alternative 6, including environmental mitigation, is estimated at $199.7 million (Table 8-9), and the total annual cost is estimated at $16.0 million, including estimated interest and amortization and O&M costs (Table 8-10). The total annual benefits generated by this alternative are approximately $11.6 million without implementation of advance release and $8.6 million with implementation of moderate advance release.

Because the benefits are less than the costs for the scenarios with and without moderate advance release, Alternative 6 is not considered to be economically feasible. Thus, there is no Federal interest in this alternative.

**TABLE 8-7.** Estimated Costs of Alternative 5 (Stepped Release to 160,000 cfs) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost**[a] | |
| 01 | Lands and damages | 2.1 |
| 02 | Relocations | 47.7 |
| 11 | Levees and floodwalls | 31.0 |
| 13 | Pumping plants | 22.1 |
| 18 | Cultural resources | 1.1 |
| 06 | Environmental mitigation | 23.8 |
| 30, 31 | Engineering, design, supervision, & administration | 30.4 |
| | Sunk PED costs | 16.5 |
| | **Total first cost** | **174.7** |

[a] Costs are October 2000 price level

**TABLE 8-8.** Benefits and Costs of Alternative 5 (Stepped Release to 160,000 cfs) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 174.7 |
| Less cultural resources (data recovery) | (1.1) |
| Interest during construction | 24.7 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **181.8** |
| **Annual Cost** | |
| Interest & amortization [b] | 12.1 |
| Operation and maintenance cost | 1.7 |
| Replacement costs for pumping plants [c] | 0.2 |
| **Total annual cost** | **14.0** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 8.1 |
| **Total benefits** | **8.1** |
| **Net annual benefits** | **(5.9)** |
| **Benefit-to-cost ratio** | **0.6** |
| ***Moderate Advance Release (0-100,000-190,000 Acre-Feet)*** | |
| Flood damage reduction | 5.7 |
| **Total benefits** | **5.7** |
| **Net annual benefits** | **(8.3)** |
| **Benefit-to-cost ratio** | **0.4** |

[a] Does not include PED sunk cost.

[b] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[c] The higher water surface elevations caused by the increased releases could adversely affect the operation of many pumping and drainage facilities in the City and County of Sacramento.

**TABLE 8-9.** Estimated Costs of Alternative 6 (Stepped Release to 160,000 cfs and New Outlet at Folsom Dam) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost** [a] | |
| 01 | Lands and damages | 2.1 |
| 02 | Relocations | 47.7 |
| 11 | Levees and Floodwalls | 31.0 |
| 13 | Pumping Plants | 22.1 |
| 18 | Cultural resources | 1.1 |
| 06 | Environmental mitigation | 23.8 |
| 30, 31 | Engineering, design, supervision, & administration | 30.4 |
| | New Outlet | 25.0 |
| | Sunk PED Costs | 16.5 |
| | **Total First Cost** [b] | **199.7** |

[a] Costs are October 2000 price level.

[b] Does not include PED sunk cost.

**TABLE 8-10.** Benefits and Costs of Alternative 6 (Stepped Release to 160,000 cfs and New Outlet at Folsom Dam) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 199.7 |
| Less cultural resources (data recovery) | (1.1) |
| Interest during construction | 28.6 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **210.7** |
| **Annual Cost** | |
| Interest & amortization [b] | 14.1 |
| Operation and maintenance cost | 1.7 |
| Replacement costs for pumping plants [c] | 0.2 |
| **Total annual cost** | **16.0** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 11.6 |
| **Total benefits** | **11.6** |
| **Net annual benefits** | **(4.4)** |
| **Benefit-to-cost ratio** | **0.7** |
| ***Moderate Advance Release 0-100,000-190,000 Acre-Feet*** | |
| Flood damage reduction | 8.6 |
| **Total benefits** | **8.6** |
| **Net annual benefits** | **(7.4)** |
| **Benefit-to-cost ratio** | **0.5** |

[a] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[b] The higher water surface elevations caused by the increased releases could adversely affect the operation of many pumping and drainage facilities in the City and County of Sacramento.

[c] The spillway bridge would be built earlier than it would otherwise be under the No-Action Plan resulting in a cost savings.

## 8.6 Alternative 7: Stepped Release to 180,000 cfs

### 8.6.1 Environmental Effects and Mitigation

Construction-related activities associated with this alternative would have less-than-significant effects on land use and socioeconomics, water supply, hydropower, soils and geology, and visual resources. Construction-related activities would have potentially significant effects on fisheries, vegetation and wildlife, the valley elderberry longhorn beetle, traffic, water quality, air quality, public health and safety, and noise. Potential effects on fisheries, water quality, traffic, and public health and safety would be mitigated to a less-than-significant level by implementing best management practices. Best management practices to reduce noise effects on residences along the Lower American River would be implemented; however, this effect would remain significant. Potential effects on air quality also would remain significant depending on the availability of emission credits. To reduce potential effects on recreation, closure notification and alternate routes would be provided to the extent feasible. However, with the temporary reduction in parking spaces at various locations, effects on recreation would remain significant.

In addition, project construction would result in the loss of 31.8 acres of riparian habitat, 0.3 acre of shaded riverine aquatic, and 20 acres of oak woodland. Approximately 137 elderberry shrubs also would be directly affected from project construction. These effects would be mitigated by developing 31.8 acres of riparian woodland at an appropriate site, such as Mississippi Bar, and 71 acres of oak woodland at Rossmoor Bar. A minimum of 0.3 acre of shaded riverine aquatic habitat would be planted at the Howe Avenue bridge-raising site. Compensation for the 137 elderberry shrubs would be included in the riparian and oak woodland plantings.

Construction of the hydraulic mitigation features would result in the loss of 16.6 acres of riparian woodland, 5.2 acres of oak woodland, 23.2 acres of freshwater marsh, 11.3 acres of open water, and 12.5 acres of rice fields. Construction of the hydraulic mitigation features could adversely affect the Federally listed giant garter snake, delta smelt, and Sacramento splittail as well as the State-listed Swainson's hawk. Mitigation would consist of creating 18 acres of riparian woodland, and 17.7 acres of oak woodland on Egbert Tract. To mitigate for adverse effects on Federally listed species, 141 acres of wetlands would be developed at Egbert Tract. Mitigation for the State-listed Swainson's hawk would consist of a buffer of up to 1/2 mile around any active nest.

To address potential effects on cultural resources, a programmatic agreement between the Corps, Bureau, California State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented.

### 8.6.2 Plan Economics

The total first cost of Alternative 7, including environmental mitigation, is estimated at $191.8 million (Table 8-11), and the total annual cost is estimated at $15.4 million (Table 8-12). The total annual benefits generated by this alternative are approximately $15.4 million without implementation of advance release and $11.8 million with implementation of moderate advance release.

Because the benefits are less than the costs for the scenario with moderate advance release, Alternative 7 is not considered to be economically feasible. Thus, there is no Federal interest in this alternative.

## 8.7 Alternative 8: Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation

### 8.7.1 Environmental Effects and Mitigation

The potential environmental effects of implementing Alternative 8 are described above, under the discussions of Alternatives 3 and 5e.

### 8.7.2 Plan Economics

The total first cost of Alternative 8, including environmental mitigation, is estimated at $337.4 million (Table 8-13). With an interest rate of 6.375 percent and a 50-year period of economic evaluation, the total annual cost of Alternative 8 is estimated at $27.6 million, including O&M costs of $2.8 million. Because this is a dual-purpose alternative that would reduce flood damages and address Folsom Dam's dam safety deficiency, the separable cost/remaining benefit procedure has been used to determine the portion of this cost that is allocable to flood control. The resulting allocation is $18.3 million (Table 8-14).

The total annual benefits are $29.3 million without implementation of advance release and $23.2 million with implementation of moderate advance release (0-100,000-190,000 acre-feet) (Table 8-14). The net benefits are the total annual benefits minus the annual costs allocable to flood control. These net benefits are $11.0 million (no advance release) and $4.9 million (moderate advance release). This alternative appears to be economically feasible because the benefits exceed costs. However, more detailed cost estimates may show increased costs for bridge raising and mitigation features along the Sacramento and American Rivers and Steamboat Slough. Moreover, assuming the dam raise is treated as the first increment, the addition of downstream improvements to accommodate stepped release as a second increment would not be economically justified, so there would be no Federal interest in this increment.

## 8.8 Summary Comparison of Flood Damage Reduction Alternatives

### 8.8.1 Comparison of Alternatives

Table 8-15 is a summary comparison of the physical features and costs and benefits of the No-Action Alternative and the seven action alternative plans. The table shows basic physical differences in the two classes of flood control alternatives: Folsom Dam enlargement and downstream levees modification.

Folsom Dam enlargement relies on increasing storage in Folsom Dam without further modifying downstream flows. In addition, Folsom Dam enlargement resolves the issue of dam safety. Because dam safety is an existing problem, the resolution of which is beneficial to the dam's existing uses, the flood control cost is made separate and economic analysis is based on this separate flood control cost.

**TABLE 8-11.** Estimated Costs of Alternative 7 (Stepped Release to 180,000 cfs) ($ millions)

| MCACES Account | Item | Costs |
|---|---|---|
| | **First Cost** [a] | |
| 01 | Lands and damages | 2.1 |
| 02 | Relocations | 60.5 |
| 11 | Levees and Floodwalls | 33.4 |
| 13 | Pumping Plants | 22.1 |
| 18 | Cultural resources | 1.3 |
| 06 | Environmental mitigation | 23.8 |
| 30, 31 | Engineering, design, supervision, & administration | 32.1 |
| | Sunk PED Costs | 16.5 |
| | **Total first cost** | **191.8** |

[a] Costs are October 2000 price level.

**TABLE 8-12.** Benefits and Costs of Alternative 7 (Stepped Release to 180,000 cfs) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 191.8 |
| Less cultural resources (data recovery) | (1.3) |
| Interest during construction | 27.1 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** | **201.1** |
| **Annual Cost** | |
| Interest & amortization [a] | 13.4 |
| Operation and maintenance cost | 1.8 |
| Replacement costs for pumping plants [b] | 0.2 |
| **Total annual cost** | **15.4** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 14.4 |
| Advance replacement of Howe Avenue Bridge [c] | 1.0 |
| **Total benefits** | **15.4** |
| **Net annual benefits** | **0.0** |
| **Benefit-to-cost ratio** | **1.0** |
| ***Advance Release 0-100,000-190,000 Acre-Feet*** | |
| Flood damage reduction | 10.8 |
| Advance replacement of Howe Avenue Bridge [c] | 1.0 |
| **Total benefits** | **11.8** |
| **Net annual benefits** | **(4.0)** |
| **Benefit-to-cost ratio** | **0.8** |

[a] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[b] The higher water surface elevations caused by the increased releases could adversely affect the operation of many pumping and drainage facilities in the City and County of Sacramento

[c] The Howe Avenue bridge would be replaced earlier than it would otherwise be under the No-Action Plan resulting in a cost savings.

**TABLE 8-13.** Estimated Costs of Alternative 8 (Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation) ($ millions)

| MCACES Account | Item | Seven-Foot Raise Costs | 160,000 cfs Costs | Subtotals |
|---|---|---|---|---|
| | **First Cost** [a] | | | |
| 01 | Lands and damages | 3.5 | 2.1 | 5.6 |
| 02 | Relocations | 0.0 | 47.7 | 47.7 |
| 04 | Construction | 123.1 | 0.0 | 123.1 |
| 11 | Levees and Floodwalls | 0.0 | 31 | 31.0 |
| 13 | Pumping Plants | 0.0 | 22.1 | 22.1 |
| 18 | Cultural resources | 1.2 | 1.1 | 2.3 |
| 06 | Environmental mitigation | 6.2 | 23.8 | 30.0 |
| 30, 31 | Engineering, design, supervision, & administration | 28.7 | 30.4 | 59.1 |
| | Sunk PED Costs | 16.5 | 16.5 | 16.5 [b] |
| | **Total first cost** | **179.2** | **174.7** | **337.4** |

[a] Costs are October 2000 price level.

[b] Sunk PED cost counted only once.

**TABLE 8-14.** Benefits and Costs of Alternative 8 (Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation) ($ millions)

| Item | Cost |
|---|---|
| **Investment Cost** | |
| Total first cost | 337.4 |
| Less cultural resources (data recovery) | (2.3) |
| Interest during construction | 49.9 |
| Less PED sunk cost | (16.5) |
| **Total investment cost** [a] | **368.5** |
| **Annual Cost** | |
| Interest & amortization [b] | 24.6 |
| Operation and maintenance cost | 2.8 |
| Replacement costs for pumping plants [c] | 0.2 |
| **Total annual cost** | **27.6** |
| **Annual Cost Allocable to Flood Control** [d] | **18.3** |
| **Annual Benefits** | |
| ***No Advance Release*** | |
| Flood damage reduction | 26.0 |
| Folsom modification project surcharge cost savings [e] | 3.1 |
| Advance replacement of spillway bridge [f] | 0.2 |
| **Total benefits** | **29.3** |
| **Net annual benefits** | **11.0** |
| **Benefit-to-cost ratio** | **1.6** |
| ***Advance Release 0-100,000-190,000 Acre-Feet*** | |
| Flood damage reduction | 19.9 |
| Folsom modification project surcharge cost savings [e] | 3.1 |
| Advance replacement of spillway bridge [f] | 0.2 |
| **Total benefits** | **23.2** |
| **Net annual benefits** | **4.9** |
| **Benefit-to-cost ratio** | **1.3** |

[a] Does not include PED sunk cost

[b] Interest and amortization rates are 6.375 and 0.304 percent, respectively.

[c] The higher water surface elevations caused by the increased releases could adversely affect the operation of many pumping and drainage facilities in the City and County of Sacramento.

[d] Calculated by using the Separable Cost / Remaining Benefits process

[e] The annual cost of the surcharge component of Folsom Modifications Project would no longer be necessary with this alternative.

[f] The spillway bridge would be built earlier than it would otherwise be under the No-Action Plan, resulting in cost savings.

**TABLE 8-15**. Summary Comparison of the No Action Plan and Project Alternatives ($ millions)

| Items | Plans | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Alternative 1: No-Action** | **Alternative 2: 3.5-Foot Dam Raise/478-Foot Flood Pool Elevation** | **Alternative 3: Seven-Foot Dam Raise/482-Foot Flood Pool Elevation** | **Alternative 4: Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation** | **Alternative 5: Stepped Release to 160,000 cfs** | **Alternative 6: Stepped Release to 160,000 cfs and New Outlet At Folsom Dam** | **Alternative 7: Stepped Release to 180,000 cfs** | **Alternative 8: Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482 Flood Pool Elev.** |
| Relative Performance [a] | | | | | | | | |
| Annual Exceedance Probability (1-in-X chance per year) | 0.0061 (164) | 0.0053 (189) | 0.0047 (213) | 0.0043 (233) | 0.0058 (172) | 0.0054 (185) | 0.0051 (196) | 0.0045 (222) |
| Long-term risk of exceedance over 50-year period (%) | 26 | 23 | 21 | 20 | 25 | 24 | 23 | 20 |
| Reduction in Flood Risk (%) | - | 13 | 23 | 30 | 5 | 11 | 16 | 26 |
| Conditional Probability of passing 200-year storm (%) | 48 | 57 | 64 | 69 | 53 | 56 | 60 | 68 |
| Percent of PMF passed over spillway (%) | 70 | 100 | 100 | 100 | 70 | 70 | 70 | 100 |
| Features | | | | | | | | |
| Folsom Dam & Reservoir | | | | | | | | |
| Flood control space (1,000 ac-ft) | 400/600 | 447/647 | 495/695 | 557/757 | 400/600 | 400/600 | 400/600 | 400/600 |
| Maximum objective release (1,000 cfs) | 115 | 115 | 115 | 115 | 160 | 180 | 160 | 160 |
| Lower American River | | | | | | | | |
| Stabilize/modify levees (miles) | | | | | 3 | 3 | 30.8 | 3 |
| Raise/replace bridges | | | | | 0 | 0 | 3 | 0 |
| Cost/Benefit Comparison [b] [c] | | | | | | | | |
| Cost ($ million) | | | | | | | | |
| First cost | | 176.1 | 179.2 | 314.8 | 174.7 | 199.7 | 191.8 | 337.4 |
| Annual cost | - | 12.7 | 13.4 | 24.1 | 14.0 | 16.0 | 15.4 | 27.6 |
| Annual cost allocable to flood control | - | 5.1 | 6.6 | 16.2 | 14.0 | 16.0 | 15.4 | 18.3 |
| Expected Annual Benefit ($ million) [d] | | | | | | | | |
| Annual benefit ($ million) | - | 12.2 | 18.9 | 23 | 5.7 | 8.6 | 11.8 | 23.2 |
| Net annual flood control benefit ($ million) | - | 7.1 | 12.3 | 6.8 | -8.3 | -7.4 | -3.6 | 4.9 |
| Percent reduction in flood damages | - | 12 | 22 | 28 | 8 | 12 | 15 | 28 |

[a] Performance is based on moderate advance release as the without-project condition. See tables under individual alternatives earlier in Chapter 5 for performance based on no advance release.

[b] October, 2000 price levels, 50-year economic project life, and 6-3/8 percent interest rate.

[c] Costs and benefits for plans shown here are not directly comparable to alternatives with similar features described in the 1996 SIR. This is primarily due to changes in without project conditions and overall scope changes for each plan. The detention dam described in the SIR would provide 1 in 500 percent chance of exceedance in any year, would still provide the most flood damage reduction benefits, and is still the NED plan.

[d] Expected annual benefits are future with moderate advanced release.

The downstream levee modification class of alternatives relies on increasing the objective release and, in one instance, increasing the emergency release from Folsom Dam. These alternatives rely on strengthening and extending levees and the attendant relocation of bridges and utilities as well as modification of local drainage facilities. A major cost of this class of alternatives is mitigation for downstream hydraulic effects that tend to increase flood risk. These downstream levee improvements have high costs that far exceed the benefits, making the stepped release alternatives uneconomical from a Federal planning perspective.

The low benefits compared to costs of Alternative 8 indicate that combining Folsom Dam enlargement with downstream levees modification does not generate any synergistic benefit or efficiency. It is not apparent that other combinations could work or are worth pursuing.

All alternatives were analyzed using no advance release and moderate advance release scenarios. Alternative 4 also was tested against a without-project condition of Upper Bound Advance Release to show the economic effect of the highest conceivable advance release scenario.

All the stepped release alternatives include extensive hydraulic mitigation in improvements to the downstream levee system to accommodate the substantial increase in floodflows.

As shown in Table 8-15, Alternatives 2, 3 and 4 are the only alternatives with positive net benefits. In addition, dam safety improvements are included in these alternatives that would correct the existing safety inadequacies.

### 8.8.2 Project Evaluation

Table 8-16 is a summary comparison of the plans' consistency with the established Corps planning criteria of (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. These criteria and evaluation of the project alternatives by established criteria are described below.

#### Completeness

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure realization of the planned objectives. A complete alternative (1) meets the objectives, (2) needs no further actions for complete fulfillment of the project, (3) is consistent and reliable, (4) is capable of being physically implemented, and (5) mitigates unavoidable adverse environmental effects, as appropriate.

All the alternative plans are expected to meet the objective of public agency and community group consensus based the issues that prevented authorization of a complete project in 1996 that have been eliminated in each of the plan alternatives under consideration at this time. However, only Alternative 4 or 8 would meet the objective of providing the city of Sacramento with a minimum expected exceedance probability of 0.0050 (1-in-200 chance per year) with a reliability of achieving this level of protection equal to or greater than the reliability of the existing flood control system. The remaining alternative plans would need further actions

to complete fulfillment of the project. Once constructed, Alternative 4 or 8 would consistently and reliably increase the capacity of the flood control system. The stepped release alternatives are consistent and reliable as long as the operations are done in strict accordance with specified floodflow releases. Constructability analysis of the dam raise alternatives and downstream levee improvements needed for the stepped release alternatives indicates that both types of flood control features can be physically implemented. Environmental compliance documentation has been completed for the outlet works modification and surcharge components, and appropriate mitigation has been provided.

**Effectiveness**

Effectiveness is the extent to which an alternative resolves the identified problems and achieves the specified objective(s). The effectiveness of the alternatives is defined by the reduction in flood damages and the realization of the community objective of providing a minimum expected exceedance probability of 0.0050 (1-in-200 chance per year).

**Efficiency**

Efficiency is the extent to which an alternative is the most cost-effective means of alleviating the identified problems while realizing the specified objectives consistent with protecting the nation's environment. One measure of efficient is monetary costs versus benefits. Efficiency is shown as net economic benefits and is the extent to which the economic benefits exceed costs.

Of the alternatives, Alternatives 3 and 4 most efficiently solve flood control problems.

**Acceptability**

Acceptability is the workability and viability of an alternative to other Federal agencies, affected State and local agencies, and public entities, given existing laws, regulations, and public policies. Two primary dimensions to acceptability are implementability and satisfaction. Implementability relates to whether the alternative is feasible from technical, environmental, economic, financial, political, legal, institutional, and social perspectives. Support by a local sponsor, other agencies, and the public is of prime importance in this category. The satisfaction was based on input from the staff of The Reclamation Board, SAFCA, and the Bureau and a public assessment vote that residents recently passed. This assessment involved an increase in their SAFCA assessments to pay for flood control and restoration projects, including the Folsom Dam Modification Project.

No known environmental effects are extensive, controversial, or unlawful. All effects are mitigated as much as is practicable. The action complies with the Federal and State Endangered Species Acts.

### 8.8.3 Derivation of Federally Supportable Plan

The alternatives evaluated in this report were derived based on the language in Section 566 of the WRDA of 1999. This language specifically directs the study to assess flood control

**TABLE 8-16.** Summary Comparison of Plans

| Plan | Plan Formulation Criteria | | | | Relative Ranking |
|---|---|---|---|---|---|
| | **Completeness** | **Effectiveness** | **Efficiency** | **Acceptability** | |
| Folsom Dam Enlargement | Technically feasible, all alternatives provide decrease in flood risk without further actions. Folsom Dam operations are not affected<br><br>Significant environmental effects are avoided or mitigated.<br><br>No significant adverse impacts on downstream conditions.<br><br>All sized alternatives resolve Folsom Dam safety. | Provides low to high decrease in flood risk. Larger sized dam raises are more effective. Alternatives 2 would require additional action to reduce flood risk to community goal of 1 in 200 protection. Alternative 3 & 4 exceed this goal. | Efficiency generally increases with size of dam enlargement. Alternative 2 is small, but has positive net benefits. Alternative 3 is the most efficient. Alternative 4 has moderate net benefits. The high cost of stability features reduces the net benefits. | All enlargement alternatives are viable and implementable given existing laws & policy.<br><br>Local satisfaction and sponsor support will be assessed during the public review of the draft document. | |
| Alt. 2: 3.5-Foot Dam Raise/478-Foot Flood Pool Elevation | High | Moderate | Moderate | Acceptable | Moderate |
| Alt. 3. Seven-Foot Dam Raise/482-Foot Flood Pool Elevation | High | High (exceeds community goal of 1 in 200 annual flood risk) | High | Acceptable | High |
| Alt. 4. Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation | High | High (exceeds community goal of 1 in 200 annual flood risk) | Moderate | Acceptable | High |
| Downstream Levee Modifications | Technically feasible, all alternatives provide decrease in flood risk without further actions. More of a reliance on levees than enlargement alternatives.<br><br>Requires extensive hydraulic mitigation features. Levee work difficult to implement due to Narrow construction window. | Provides low to moderate decrease in flood risk. No alternative reduce flood risk to community goal of 1 in 200 protection. | Negative net economic benefits, no alternative is economical. Large residual flood damages. | All downstream levee alternatives are viable and implementable given existing laws & policy.<br><br>Local satisfaction and sponsor support unlikely due to no Federal interest. | |
| Alt. 5. Stepped Release to 160,000 cfs | Moderate/Low | Low | Inefficient | Acceptable | Very Low |
| Alt. 6. Stepped Release to 160,000 cfs and New Outlet at Folsom Dam | Moderate/Low | Low | Inefficient | Acceptable | Very Low |
| Alt. 7. Stepped Release to 180,000 cfs | Moderate/Low | Moderate | Marginal | Acceptable | Low |
| Combination<br>Alt. 8. Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation | Technically feasible, all alternatives provide decrease in flood risk without further actions.<br><br>Levee work difficult to implement due to Narrow construction window.<br><br>Moderate/High | Provides a major decrease in flood risk, second only to Alternative 4.<br><br>High | Marginal with or without advance release. With advance release is inefficient. Positive net economic benefits, but stepped release not economic as 2nd increment<br><br>Low | Alternative is viable and implementable<br><br>Sponsor support unlikely due to no Federal interest.<br><br>Acceptable | Low |

through "increasing surcharge flood control storage at the Folsom Dam and Reservoir" in subsection (a) and through "levee modification" in subsection (b). Thus, all Folsom Dam enlargement alternatives are compared to identify the enlargement alternative that best meets planning objectives and has the highest net benefits (benefits minus costs). This is identified as the Federally supportable Folsom enlargement plan. Similarly, all stepped release plans are compared to identify the Federally supportable downstream levee plan. The Federally supportable Folsom enlargement plan may be used as a basis for establishing the Federal share of the cost of a locally preferred plan involving the enlargement of Folsom Dam. Similarly, the Federally supportable downstream levee plan may be used as the basis for establishing the Federal share of the cost of a locally preferred plan involving stepped release improvements.

Table 8-17 displays the derivation for the Federally supportable Folsom enlargement plan. Net benefits are shown for each alternative for each advance release scenario. Alternative 3 has the highest net benefits and would be the Federally supportable plan. As shown in Table 8-18, none of the downstream levee alternatives has positive net benefits (benefits greater than total annual costs); thus, none of the alternatives are considered economically feasible and therefore will not be further evaluated in this study. Because there is no downstream levee plan with positive net benefits, the study identifies no Federally supportable downstream levee plan.

**TABLE 8-17.** Derivation for the Federally Supportable Folsom Enlargement Plan

| | No Advance Release | Moderate Advance Release[a] |
|---|---|---|
| **Alternative 1: No Action** | | |
| Average annual benefit | NA | NA |
| Total annual cost | NA | NA |
| Net benefit | | |
| **Alternative 2: 3.5-Foot Dam Raise/478-Foot Flood Pool Elevation** | | |
| Average annual benefit | 12.4 | 12.2 |
| Annual cost allocable to flood control | 5.1 | 5.1 |
| Net benefit | 7.3 | 7.1 |
| **Alternative 3: Seven-Foot Dam Raise/482-Foot Flood Pool Elevation** | | |
| Average annual benefit | 20.5 | 18.9 |
| Annual cost allocable to flood control | 6.6 | 6.6 |
| Net benefit | 13.9 | 12.3 |
| **Alternative 4: Twelve-Foot Dam Raise/487-Foot Flood Pool Elevation** | | |
| Average annual benefit | 27.5 | 23.0 |
| Annual cost allocable to flood control | 16.2 | 16.2 |
| Net benefit | 11.3 | 6.8 |
| **Alternative 8: Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation)** | | |
| Average annual benefit | 29.3 | 23.2 |
| Annual cost allocable to flood control | 18.3 | 18.3 |
| Net benefit | 11.0 | 4.9 |

[a] Without-project advance release scenario adopted by this study and on which recommendations will be made.

NA = not applicable.

**TABLE 8-18.** Derivation for the Federally Supportable Downstream Levee Modification Plan

| | No Advance Release | Moderate Advance Release [a] |
|---|---|---|
| **Alternative 1: No Action** | | |
| Average annual benefit | NA | NA |
| Total annual cost | NA | NA |
| Net benefit | | |
| **Alternative 5: Stepped Release to 160,000 cfs** | | |
| Average annual benefit | 8.1 | 5.7 |
| Total annual cost | 14.0 | 14.0 |
| Net benefit | (5.9) | (8.3) |
| **Alternative 6: Stepped Release to 160,000 cfs and New Outlet at Folsom Dam** | | |
| Average annual benefit | 11.6 | 8.6 |
| Total annual cost | 16.0 | 16.0 |
| Net benefit | (4.4) | (7.4) |
| **Alternative 7: Stepped Release to 180,000 cfs** | | |
| Average annual benefit | 15.4 | 11.8 |
| Total annual cost | 15.4 | 15.4 |
| Net benefit | 0.0 | (3.6) |
| **Alternative 8: Stepped Release to 160,000 cfs and Seven-Foot Dam Raise/482-Foot Flood Pool Elevation** | | |
| Average annual benefit | 29.3 | 23.2 |
| Total annual cost | 18.3 | 18.3 |
| Net benefit | 11.0 | 4.9 |

[a] Without-project advance release scenario adopted by this study and on which recommendations will be made.